IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant	: Shunpei Yamazaki, et al.	Art Unit	: 1722
Serial No.	: 09/892,225	Examiner	: Mathew J. Song
Filed	: June 25, 2001	Conf. No.	: 1969
Title	: SEMICONDUCTOR DEVICE AND FABRICATION METHOD THEREFOR		

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REPLY TO ACTION OF SEPTEMBER 20, 2006

Claims 5-7, 15-19, 23, 29-31 and 35-68 are pending in this application, with claims 5, 6, 15, 16, 35, 36, 39 and 40 being independent.

Independent claims 5, 6, 35, 36, 39 and 40, along with their dependent claims 7, 23, 37, 38 and 41, have been rejected as being unpatentable over Noguchi (JP 04-168769) in view of Shimizu (U.S. Patent No. 5,753,541) or Tsutsu (U.S. Patent No. 6,118,151).

Each of the independent claims recites a method of manufacturing a semiconductor device that includes, among other features, forming a first amorphous semiconductor film that includes silicon and germanium "wherein a concentration of the germanium is within a range of 0.1 atom% to 10 atom%" and "forming a second amorphous semiconductor film ... so that a combined thickness of the first and second amorphous semiconductor films is within a range of 20-100 nm" (emphasis added).

Applicants request reconsideration and withdrawal of the rejections of claims 5, 6, 35, 36, 39 and 40, and their dependent claims, because neither Noguchi, Shimizu, Tsutsu, nor any proper combination of the three describes or suggests forming a first amorphous film of silicon and germanium with a concentration of the germanium within a range of 0.1 atom% to 10 atom% and forming a second amorphous semiconductor film so that a combined thickness of the first and second amorphous semiconductor films is within a range of 20-100 nm.

In the response to the Office Action of March 9, 2006, applicants stated the following in support of the request that these rejections be withdrawn:

> "The Examiner acknowledges that the combination of Noguchi and Shimizu and the combination Noguchi and Tsutsu do not explicitly disclose the feature of forming the recited amorphous film of silicon and germanium with a concentration of the germanium

within a range of 0.1 atom% to 10 atom%. See page 5 of the Office Action. Nevertheless, the Examiner asserts that it would have been obvious to a person of ordinary skill in the art at the time of the invention to optimize, through routine experimentation of a result effective variable, the germanium concentration depicted in Fig. 2 of Noguchi, which depicts a broad range of germanium concentration, to obtain the claimed narrower germanium concentration range of 0.1 atom% to 10 atom%. See pages 5 and 6 of the Office Action.

MPEP § 2144.05 states "[g]enerally, differences in concentration or temperature will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. '[W]here the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation.' *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955)" (emphasis added). Applicants refer the Examiner to page 35, lines 6 to 13 of the application, reproduced below, as evidence that the claimed concentration range of 0.1 atom% to 10 atom% and the claimed thickness range of 20-100 nm of the recited first and second amorphous semiconductor films are critical ranges that support patentability:

> "such a crystalline semiconductor film which exhibits a high orientation with respect to the {101} plane is achieved not only by the addition of germanium at a concentration which is in the range of 0.1-10 atomic %, but also by the synergistic effect of the processing of adjusting the concentration of each element such as oxygen, nitrogen and carbon contained in the film to less than $1x10^{19}$ /cm^3 and the processing of setting the thickness of the crystalline semiconductor film within the range of 20-100 nm so that crystal growth predominates in a direction parallel to the substrate surface."

As described in the application specification, the claimed concentration and thickness ranges are critical as they lead to a synergistic effect that results in a crystalline semiconductor film having a desirable high orientation with respect to the {101} plane. In contrast, neither Noguchi nor any of the other cited art describes or suggests the existence of this unexpected synergistic effect at these critical ranges that results in a crystalline film having an improved crystal orientation."

In the Final Office Action, the Examiner responded to these arguments by stating:

> "Applicant's argument that the claimed concentration and thickness ranges are critical is noted but not found persuasive. Applicant's argument relies on a portion of the specification which states: [same quote from the application specification as shown above]. Applicants have merely stated that the ranges are critical without providing any experimental data to support the argument for criticality; therefore the argument is not found persuasive."

Applicant's disagree. Contrary to the Examiner's assertions, the statements in the application specification are evidence in and of themselves. Applicants are not aware of any requirement

that the only evidence that may be considered to determine whether a temperature range is critical is experimental data, as suggested by the Examiner. The inventors, through the application, have submitted statements as evidence that the particular concentration and thickness ranges are critical, stating that having a concentration and a thickness within the recited ranges is necessary for the "synergistic effect" that leads to the unexpected results of improved crystal orientation with respect to the {101} plane. The inventors and their representatives are under a duty of good faith and candor when dealing with the Patent Office. Absent any evidence to the contrary, these statements should be taken at face value and should be sufficient as evidence of the criticality of the recited temperature and thickness ranges.

For at least these reasons, applicants request reconsideration and withdrawal of the rejections of claims 5, 6, 35, 36, 39 and 40, and their dependent claims 7, 23, 37, 38 and 41, because none of the cited art describes or suggests forming a first amorphous film of silicon and germanium with a concentration of the germanium within a range of 0.1 atom% to 10 atom% and forming a second amorphous semiconductor film so that a combined thickness of the first and second amorphous semiconductor films is within a range of 20-100 nm.

Claims 65-68, which depend from claims 35, 36, 39 and 40, have been rejected as being unpatentable over Noguchi in view of Shimizu and Applicant's Admitted Prior Art (AAPA) and over Noguchi in view of Tsutsu and AAPA. However, AAPA does not remedy the failure of Noguchi, Shimizu and Tsutsu to describe or suggest the subject matter of claims 35, 36, 39 and 40. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 65-68.

Independent claims 15 and 16, and their dependent claims 17, 29, 63 and 64, have been rejected as being unpatentable over Noguchi in view of Shimizu and AAPA and over Noguchi in view of Tsutsu and AAPA.

Independent claim 15 recites a method of manufacturing a semiconductor device including, among other features, "forming a first amorphous semiconductor film comprising/including silicon and germanium on the insulating surface/film wherein a concentration of the germanium is within a range of 0.1 atom% to 10 atom%" and "forming a second amorphous semiconductor film ... so that a combined thickness of the first and second amorphous semiconductor films is within a range of 20-100 nm" (emphasis added). Independent

claim 16 recites, among other features, "forming a first amorphous semiconductor film including silicon and an element having a larger atomic radius than silicon on an insulating surface wherein a concentration of said element is within a range of 0.1 atom% to 10 atom%" and "forming a second amorphous semiconductor film ... so that a combined thickness of the first and second amorphous semiconductor films is within a range of 20-100 nm" (emphasis added). For at least the reasons described above, applicants request reconsideration and withdrawal of the rejection of claims 15 and 16, and their dependent claims 17, 29, 63 and 64. In particular, neither Noguchi, Shimizu, Tsutsu, AAPA, nor any proper combination of the four describes or suggests the features of independent claims 15 and 16.

Claims 43 and 46, which depend from independent claims 39 and 40, have been rejected as being unpatentable over Noguchi in view of Shimizu and Zhang (U.S. Patent No. 5,578,520) and over Noguchi in view of Tsutsu and Zhang. Claims 19 and 31, which depend from independent claims 15 and 16, have been rejected as being unpatentable over Noguchi in view of Shimizu, Zhang, and AAPA, and over Noguchi in view of Tsutsu, Zhang, and AAPA. However, Zhang does not remedy the failure of Noguchi, Shimizu, AAPA, and Tsutsu to describe or suggest the subject matter of claims 15, 16, 39 and 40. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 19, 31, 43 and 46.

Claims 42 and 45, which depend from claims 39 and 40, respectively, have been rejected as being unpatentable over Noguchi in view of Shimizu and Maekawa (U.S. Patent No. 6,066,547) and over Noguchi in view of Tsutsu and Maekawa. Claims 18 and 30, which depend from claims 15 and 16, respectively, have been rejected as being unpatentable over Noguchi in view of Shimizu, AAPA and Maekawa, and over Noguchi in view of Tsutsu, AAPA and Maekawa. However, Maekawa does not remedy the failure of Noguchi, Shimizu, Tsutsu and AAPA to describe or suggest the subject matter of claims 15, 16, 39 and 40. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 18, 30, 42 and 45

Claims 47, 48 and 51-54, which depend from claims 5, 6, 35, 36, 39 and 40, have been rejected as being unpatentable over Noguchi in view of Shimizu and Kunii (JP 04-163910), over Noguchi in view of Shimizu and Cho (JP 11-340473), over Noguchi in view of Tsutsu and Kunii, and over Noguchi in view of Tsutsu and Cho. However, Kunii and Cho do not remedy the failure of Noguchi, Shimizu, and Tsutsu to describe or suggest the subject matter of claims 5,

6, 35, 36, 39 and 40. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 47, 48 and 51-54.

Claims 49 and 50, which depend from claims 15 and 16, have been rejected as being unpatentable over Noguchi in view of Shimizu, AAPA and Kunii, over Noguchi in view of Shimizu, AAPA and Cho, over Noguchi in view of Tsutsu, AAPA and Kunii, and over Noguchi in view of Tsutsu, AAPA and Cho. As stated previously, AAPA, Cho, and Kunii do not remedy the failure of Noguchi, Shimizu, and Tsutsu to describe or suggest the subject matter of claims 15 and 16. Accordingly, applicants request reconsideration and withdrawal of the rejection of claims 49 and 50.

Independent claims 5, 6, 15, 16, 35, 36, 39 and 40, along with their dependent claims 7, 19, 31, 37, 38 and 41-68, also have been rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1, 7, 50, 51, 59, 60, and 66 of U.S. Patent No. 6,482,684 ("the '684 patent") in view of Noguchi and AAPA.

The Examiner acknowledges that claims 1, 7, 50, 51, 59, 60, and 66 of the '684 patent do not recite the limitation "forming a first amorphous semiconductor film comprising silicon and germanium on the insulating surface/film wherein a concentration of the germanium is within a range of 0.1 atom% to 10 atom%" (emphasis added), as recited in claims 5, 6, 15, 35, 36, 39, and 40. The Examiner also apparently acknowledges that claims 1, 7, 50, 51, 59, 60 and 66 of the '684 patent do not recite the limitation "forming a first amorphous semiconductor film including silicon and an element having a larger atomic radius than silicon on an insulating surface wherein a concentration of said element is within a range of 0.1 atom% to 10 atom%" (emphasis added), as recited in claim 16. The Examiner, as before, relies upon the teachings of Noguchi to cure this deficiency through routine experimentation. For at least the reasons described above, however, this feature is patentable over Noguchi. Therefore, applicants request reconsideration and withdrawal of the rejection of claims 5, 6, 15, 16, 35, 36, 39 and 40, and their dependent claims 7, 19, 31, 37, 38 and 41-54.

Applicants do not acquiesce to the characterizations of the art. For brevity and to advance prosecution, however, applicants have not addressed all characterizations of the art, but reserve the right to do so in further prosecution of this or a subsequent application.

Applicants submit that all claims are in condition for allowance.

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Respectfully submitted,

Date: 12/20/06

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